

REMARKS

In response to the above Office Action, claim 1 has been amended to make it clear that since the distribution of the foam in the aggregate granular material and the moisture content of the binder are concentrated in a center portion of the mold, "after the moisture is evaporated, the center portion of the mold has a lower density of the aggregate granular material than outer portions of the mold." See page 6, lines 19-24 of the specification.

In addition, claim 1 has been amended to make it clear that the molten metal poured into the completed mold has a temperature that "evaporates or dissolves the water-soluble binder in the mold." Support for this can be found on page 6, lines 1-5 and page 9, lines 19-25 of the specification. As noted, this allows the mold to be more easily removed from the cast article after it has solidified.

In the casting process of the present invention, one or more kinds of an aggregate granular material, one or more kinds of a water-soluble binder, and water, are mixed together to form a mixture of the aggregate granular material. The mixture is then agitated to cause it to foam such that it is formed as a foamed mixture. The foamed mixture is then charged into a molding space where it is hardened therein, so as to make a mold.

The foamed mixture is charged such that the distribution of foam within the aggregate granular material and the moisture content of the binder are concentrated at the center portion of the mold. Thus after the moisture is evaporated therefrom, the center portion of the mold has a lower density of the aggregate granular material than outer portions of the mold. Consequently, the binder is concentrated in the outer portion of the mold. For example, if the resulting mold is about 40 mm thick, more than 50% of

the water-soluble binder is aggregated in a surface layer between the surface of the mold and a depth of 10 mm therefrom. See page 6, lines 12-24 of the specification. Then when a molten metal having a high temperature (e.g., 720°C) is poured into the completed mold, the binder in the mold readily evaporates or dissolves making it easier to remove the mold from the cast article made from the molten metal. See page 6, lines 1-5 or page 9, lines 19-25 of the specification.

In the Office Action the Examiner continued to reject claims 1-7 and 12 over 35 U.S.C. §103(a) for being obvious over AAPA in view of Hitachi. Claims 1, 12 and 13 were also rejected for being obvious over AAPA in view of Hoult.

The Examiner acknowledges that AAPA neither teaches 1) that the binder is water-soluble or is either polyvinyl alcohol (PVA) or starch or a derivative thereof or 2) that the mixture of aggregate granular material, binder and water are agitated "to cause the mixture to foam and form a foamed mixture." See last paragraph on page 3 of the Office Action.

Hitachi is cited to show the use of water-soluble PVA in a method for making a casting. Hoult is cited to show the use of starch in a method for making a casting. Thus the Examiner believes it would be obvious to use PVA or starch in the process described in AAPA. The Examiner acknowledges, however, that neither Hitachi nor Hoult show that this aggregate mixture is to be agitated to cause it "to foam" and form a "foamed mixture." See page 4, third paragraph and page 7, lines 10 and 11 of the Office Action. Nevertheless, the Examiner takes the position that since mixing and agitating are the same process and the ingredients are the same, when mixing the mixture of AAPA as modified by Hitachi or Hoult, it "will cause it to foam." Therefore,

that since this "foamed" mixture of AAPA as modified by Hitachi or Hoult has the same ingredients, the distribution of the foam in the mold will necessarily result in the granular material and moisture content of the binder concentrating in a center portion of the mold as claimed.

The AAPA, discussed in the Background of the Invention, discloses a conventional shell mold process using a resin coated sand (RCS) as disclosed on page 10, lines 30-33, and shown in Fig. 2 of the present invention.

The RCS is a sand that is coated with a phenolic synthetic resin, e.g., a phenol formaldehyde resin as a "binder." See page 1, lines 8-12 of the specification. To make the RCS, heated sand having a temperature of 130 to 160°C and a solid phenol resin are mixed in a mixer. The resin is then melted by means of the temperature from the heated sand such that the melted resin coats the sand. If the phenol resin is a novolac-type phenolic resin, an aqueous solution of hexamine is added to the mixture. If the phenol resin is a resole-type phenolic resin, only water is added to the mixture. Rapidly cooling the resulting mixture by means of the evaporative latent heat of the water, by aeration, and the like, reduces the sticking between the heated sand particles. Then a wax, for example, calcium stearate, as a lubricant, is distributed in the resulting mixture to make a dry and fluid RCS (See Step 11 in Fig. 2).

In this shell mold process the phenol resin and hexamine are used as the binder and a curative agent to form the resin coated sand, i.e., the RCS. The RCS is filled in a pre-heated metal die by gravity, or injected therein by air. The filled RCS is baked to make a mold (Step 12 in Fig. 2). To make a core mold by these steps in the AAPA, the

metal dye needs to be heated to 200 to 300°C over 30 seconds to two minutes to cure the RCS.

This shell molding process using a "resin-coated sand" (RCS) as in the AAPA is the conventional method used by those skilled in the art. Considering the specifics of this process as set forth above, one skilled in the art would never have readily conceived of forming a foam of aggregated granular material such as sand as in the present invention regardless of what binders may be being used.

Hitachi may teach a method for making a mold where a water solution that includes a polyvinyl alcohol is added to sand; drying it to form a coating layer comprising the polyvinyl alcohol on the surface of each sand particle; mixing the sand in which the respective sand particles are coated with the polyvinyl alcohol and water, or an organic colloid solution, or an inorganic colloid solution, to form a material for making a mold; and making a mold using the material. Hoult may teach a method for making a mold using a mixture of particulate material, water, and a starch. Hoult also teaches freezing the mold and then pouring a molten metal into it. However, neither reference, like AAPA, discloses that the aggregate granular material is agitated with the binder "to cause the mixture to foam."

As noted above, the Examiner argues that even though none of the references discuss actually forming a foam of the mixtures, because the ingredients are the same as in the claimed mixture and the mixing step of AAPA includes agitation of the ingredients to mix them, that this will inherently cause them to foam and form a "foamed mixture." With all due respect, it is not understood how the Examiner can reach this conclusion. As pointed out in the previous Reply, simply mixing or agitating a mixture

will result in an essentially homogeneous mixture. On the other hand, as defined in the dictionary, "foam" is "a mass of gas bubbles in a liquid-film matrix" (emphasis added). Thus if a "foam" is to be formed, something more obviously needs to be done to the mixture to cause it to actually "foam" than just simply mixing or agitating it.

The Examiner's position is that this would inherently occur in the mixing step of the prior art references. As noted in M.P.E.P. §2112, IV, to support such a position, the "Examiner must provide rationale or evidence tending to show inherency." Moreover, "the fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic" (emphasis added). As further noted

To establish inherency, the extrinsic evidence "must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. (emphasis added)

The Examiner has not provided any evidence that a "foamed mixture," i.e., one where a mass of gas bubbles is present in a liquid matrix, will necessarily result simply by mixing the ingredients of the combined references. Nor has he provided any credible rationale to support his position. The most that can be said is that he has shown that it may happen. However, it may just as well not happen and as set forth in M.P.E.P. §2112, IV, this is not sufficient to show inherency.

Since none of the cited references disclose mixing the ingredients to actually form a "foamed mixture" and it has been shown that a "foamed mixture" is not the same as simply a "mixture," it is submitted that it cannot be said that "foaming" is inherently

taught in these references. Consequently, the Examiner's first basis for the rejections is not proper.

Secondly, if the mixtures of the references do not inherently form "foams," then they cannot inherently form the claimed distribution in the mold. Consequently, it is submitted that the Examiner's second basis for the rejections is also improper.

Withdrawal of the rejection of claims 1-7 and 12 over AAPA in view of Hitachi and claims 1, 12 and 13 over AAPA in view of Hoult under §103(a) is therefore requested.

It is believed claims 1-7, 12 and 13 are now in condition for allowance. If so, it would appear appropriate to rejoin withdrawn claims 8-11 since they all are dependent from claim 1.

In view of the foregoing remarks, Applicants submit that this claimed invention, as amended, is neither anticipated nor rendered obvious in view of the prior art references cited against this application. Applicants therefore request the entry of this Amendment, the Examiner's reconsideration and reexamination of the application, and the timely allowance of the pending claims.

Please grant any extensions of time required to enter this response and charge any additional required fees to Deposit Account 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

By: 

Arthur S. Garrett
Reg. No. 20,338
(202) 408-4091

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